Relative abundance of largemouth bass and warmouth in the river channel

Expectation: Centrarchid community structure will shift as a result of a significant decrease in relative abundance of *Lepomis gulosus* (warmouth) and concurrent significant increase in relative abundance of *Micropterus salmoides* (largemouth bass).

Author: J. Lawrence Glenn, III, South Florida Water Management District

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Relevant Endpoint(s): Sociopolitical - Numbers of Gamefish
Restoration - Biological Integrity - Community Structure
Restoration - System Functional Integrity - Habitat Quality

Baseline Conditions: Channelization of the Kissimmee River dramatically altered both hydrologic and geomorphic attributes of the river. Elimination of instream flow and seasonally fluctuating discharge have resulted in encroachment of emergent littoral vegetation and proliferation of floating vegetation, shallowing of remnant river runs through accumulation of dead and decomposing plant litter on the river bed, decreased dissolved oxygen levels, and elimination of over bank flow and accompanying connection of river channel and floodplain habitats. These alterations, coupled with accompanying physical and chemical changes, have caused shifts in relative abundance of species of Centrarchidae.

Dissolved oxygen regimes in the channelized system persist at the tolerance threshold (2.0 ppm) for most centrarchid species (Moss & Scott 1961, Davis 1975) and periodically reach critically low levels (<0.5 ppm) during summer months (Toth 1993, Koebel 1995), allowing tolerant species (e.g., bowfin and gar) to displace less tolerant species (e.g., largemouth bass). Elimination of flow and associated increased coverage of in-channel vegetation has allowed cover-seeking species that are more characteristic of lentic systems (e.g., *L. gulosus*) to proliferate in main channel habitats where they may have been displaced historically (Poff et al. 1997).

Post-channelization river channel fish communities were evaluated using block nets and fish toxicant (5% emulsified rotenone) during June 1997 and May 1998. Baseline block net sampling indicates a community comprised of 19 large bodied species occurs within remnant river runs in Pools A and C. The centrarchid community in Pool A was dominated by *L. macrochirus* (42.1 ± 1.4%) and *L. gulosus* (30.4 ± 7.9%), while *M. salmoides* comprised 6.1% (± 5.4)(Table 1). Centrarchid community composition within Pool C was dominated by *L. gulosus* (42.9 ± 8.1%) and *L. macrochirus* (42.7 ± 12.9%) while *M. salmoides* comprised only 4.3% (± 3.5). Dominance of *L. gulosus* under baseline conditions may be due partly to its ability to outcompete other centrarchid species under less than optimal dissolved oxygen regimes. *Lepomis gulosus* is the most tolerant centrarchid species within the channelized system to low dissolved oxygen levels (Stuber et al. 1982).

Milleson (1976) utilized block nets and fish toxicant to sample a 0.20 acre reach of remnant river in Pool B following channelization.

Lepomis gulosus comprised 16.4% of the total number of centrarchids collected, while *M. salmoides* comprised 5.9% (Table 1).

Reference Conditions:

Historical data on river channel fish community structure are limited to a single study (FGFWFC 1957), in which river channel fish were sampled using block nets and 5% emulsified rotenone. Sampling was conducted within a lower reach of the Kissimmee River, during drought conditions. *Micropterus salmoides* comprised 13.6% of the total number of centrarchids collected, while *L. gulosus* comprised 6.8% (Table 1).

Mechanism relating restoration:

Re-establishment of a fish community resembling that of the historic system requires restoration of riverine habitats that match the habitat requirements of the historic community (Sheldon & Meffe 1995). These include deep and shallow water habitats, snags, vegetated areas along the littoral fringe, and seasonally linked floodplain habitats. Restoration of the natural seasonality of floodplain inundation is critical for centrarchid species (Copp 1989) because floodplain habitat was utilized historically as nursery grounds (FGFWFC 1957). Restoration of historic hydrologic regimes will ensure that availability of inundated floodplain habitats will coincide with migratory and reproductive behavior of endemic species (Welcomme 1979, Poff et al. 1997).

Recession of water from floodplain habitats will facilitate the expected shift in centrarchid community structure by contributing food resources through export of fish and organic matter into the main channel (Welcomme 1979, Junk et al. 1989, Sparks 1995). Increased abundance of fish prey will especially benefit piscivorous species such as *M. salmoides* because survivorship, growth rates, and fecundity of this species are directly related to the quality of their diet (Keast & Eadie 1985, Bettoli et a. 1992). Increased survivorship of young of the year and subsequent recruitment into juvenile populations will lead to increased relative abundance of this species.

Seasonal high discharges will limit encroachment of littoral vegetation (Williams & Wolman 1984, Ligon et al. 1995) and reduce areal coverage of littoral vegetation communities along the river channel. *Lepomis gulosus* prefers heavily vegetated habitats with limited flow velocities (Lee et al. 1980, Stuber et al. 1982). Increased flow velocities and decreased vegetative cover will likely lead to the lateral migration of this species onto floodplain habitats (Welcomme 1979), thereby decreasing its abundance within the restored river channel.

Re-introduction of instream flows will flush accumulated organic deposits and provide topographic diversity and a range of flow velocities useful to a larger consort of species and life history stages (Bain et al. 1988, Lobb & Orth 1991, Sheldon & Meffe 1995). Zones of erosion and deposition will include scour areas (providing deep-water habitat), point bars (creating back eddies and slower current velocities), and shoals (creating spawning grounds and shallow water habitat). Erosion processes also will create snags as riparian vegetation is displaced into the river. Snags provide relief from high discharge velocities and an abundance of aquatic invertebrate prey, which use woody debris as a substrate for attachment and feeding (Benke et al. 1985, Lobb & Orth 1991).

Adjustments for External Constraints:

Increased fishing pressure may impact age structure of the community through removal of larger individuals and may have a greater affect on *M. salmoides*, because it is the most highly sought gamefish in the system (FGFWFC 1996). Reproductive potential of breeding populations is diminished by the reduction of large individuals from the community, because larger fishes are more fecund (Lack 1954, Hubbs et al. 1968, Wooten 1984). This can potentially affect abundance of year classes.

Exotic fish species may impact the centrarchid community through interspecific competition for available resources. Seven species of exotic fishes (*Astronotus ocellatus* - oscar, *Clarias batrachus* – walking catfish, *Ctenopharyngodon idella* – grass carp, *Cyprinus carpio* – common carp, *Hoplosternum littorale* – armored catfish, *Hypostomus plecostomus* – suckermouth catfish, *Oreochromis aureus* – blue tilapia) currently occur within the channelized Kissimmee River system. Several of these species possess adaptations for survival in less than optimal conditions (i.e. capable of breathing air and locomotion over land) and often thrive in newly disturbed habitats (Courtenay & Hensley 1979), such as during restoration construction phases. Established exotic communities can outcompete indigenous centrarchid communities for food, spawning areas, and space (Courtenay & Hensley 1979). However, during baseline sampling exotics comprised only 1.5% of fishes collected within the river channel fish community. Potential impacts of exotic species could increase if new species are introduced into the system (Table 2).

Time Course:

Restructuring of the centrarchid community is dependent on changes in hydrology, geomorphology, and associated biological, physical, and chemical attributes and is expected to occur within 3-5 years following re-establishment of continuous flows. Re-establishment of the forage base, including restoration of riverine invertebrate and piscine prey, as well as inputs of fishes, invertebrates, and organic matter from the floodplain, is necessary for increased fish production (Keast & Eadie 1985). Restoration of riverine invertebrate communities is expected to occur within 2 years following re-establishment of continuous flow. Reproduction rates and time periods necessary to reach sexual maturity also are limiting factors. The majority of centrarchid species occurring within the Kissimmee River reach sexual maturity between years 2 and 3 (Lee et al.1980, Stuber et al. 1982, Twomey et al. 1984, Aho et al. 1986). Restoration time frames may require adjustment if appropriate hydrologic and geomorphologic characteristics are not met.

Means of Evaluation:

Block net sampling will be conducted following 2 years of continuous flows. Methods will be identical to those utilized for baseline studies. Two sampling events will occur during two years of minimal flow within 10 years of reintroduction of continuous flows.

Differences in relative abundance will be considered significant if statistical tests result in $P \leq 0.05$. Baseline values used for comparisons of relative abundance of *L. gulosus* and *M. salmoides* for block net are 42.9% ($\pm$ 8.1) and 4.3% ($\pm$ 3.5), respectively.

Table 1. Relative abundance (percentage of total numbers) of centrarchid species sampled within block nets in the Kissimmee River. Baseline values for Pools A and C are expressed as annual means with associated standard error.

		Reference	Baseline		
Species	Common Name	GFC 1957	Milleson '76	Pool A '97-98	Pool C '97-98
GAME FISH:					
Lepomis gulosus	warmouth	6.8	16.4	30.4 ± 7.9	42.9 ± 7.9
Lepomis macrochirus	bluegill	59.1	55.0	42.1 ± 1.4	42.7 ± 12.9
Lepomis microlophus	redear sunfish	20.5	15.6	7.3 ± 1.9	3.5 ± 1.1
Lepomis punctatus	spotted sunfish	--	2.2	1.5 ± 0.9	2.7 ± 1.3
Micropterus salmoides	largemouth bass	13.6	5.9	6.1 ± 5.4	4.3 ± 3.5
Pomoxis nigromaculatus	black crappie	--	4.9	12.6 ± 6.6	4.0 ± 1.2

Table 2. Exotic fish species occurring within South Florida that could invade the restored Kissimmee River ecosystem.

Species	Common Name
Belonesox belizanus	pike killifish
Cichlasoma bimaculatum	black acara
Cichlasoma citrinellum	midas cichlid
Cichlasoma meeki	firemouth
Cichla ocellaris	peacock bass
Cichlasoma octofasciatum	Jack Dempsey
Cichlasoma uropthalmus	Mayan cichlid
Hemichromis bimaculatus	jewelfish
Monopterus albus	Asian Swamp eel
Tilapia mariae	spotted tilapia
Tilapia mossambica	Mozambique tilapia

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